8.7. NTSC Ranging (3 "D" levels except as noted)

- Co-Channel Interference (2 "D" levels)
- Upper Adjacent Channel Interference (2 "D" levels for Enhanced-NTSC systems)
- Lower Adjacent Channel Interference (2 "D" levels for Enhanced-NTSC systems)
- Linear UHF Taboos (2 "D" levels for Enhanced-NTSC systems)
- Non-Linear UHF Taboos

8.8. NTSC Transmission Impairment Rating (3 "D" levels except as noted)

- Co-Channel Interference (2 "D" levels)
- Upper Adjacent Channel Interference (2 "D" levels for Enhanced-NTSC systems)
- Lower Adjacent Channel Interference (2 "D" levels for Enhanced-NTSC systems)
- One Selected Linear UHF Taboo (2 "D" levels for Enhanced-NTSC systems)
- One Selected Non-Linear UHF Taboo

8.9. Quality Rating

- ATV Basic Quality
- NTSC Reception Quality (Enhanced-NTSC systems only)
- ATV Cable Quality
- ATV Fiber Quality

8.10. Expert Observation and Comment

- ATV Limiting Resolution
- NTSC-Compatible Limiting Resolution
- VCR Compatibility for Enhanced NTSC
- Cable High-Level Sweep

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ATV Test Procedures

Audio Subjective Tests

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1. Introduction

1.1 General

The purpose of these subjective audio tests is to ascertain the quality of the audio channels accompanying ATV systems. The subjective judgments are made by audio experts.

There are two types of subjective audio test, quality and transmission impairment. Quality tests allow a group of audio experts to listen to program material and decide on its intrinsic quality. A panel of experts will use the method of Expert Observation & Commentary (EO&C) to describe the failure characteristic of each system on each impairment.

1.2. Tests-General Description

The purpose of the tests is to obtain assessments of audio by audio experts. These tests will be recorded in advance on R-DAT and played back for groups of audio experts.

1.2.1. Quality Rating Test

The purpose of a quality test is to ascertain an impression of overall audio quality. In these tests, audio experts will compare the unimpaired audio quality of the system under test with the quality of the same audio directly from the source hereafter called the reference.

The actual method of testing is similar to the continuous quality triple-stimulus method used by the Motion Picture Expert Group (MPEG) of the International Standards Organization (ISO) in tests conducted at Sveriges Radio AB (Swedish Broadcasting Corporation). This method twice incorporates the use of a reference in a scheme consisting of three stimulus (or presentations). A first presentation of audio direct from the source (the known reference) is followed by two more presentations, one of which is, again, audio direct from the source (the hidden reference) and the other of which is audio via the system under test. The sequence of three presentations is then repeated to complete a trial. Each audio expert then individually rates the hidden reference and the system under test against the known reference.

At least twenty audio experts are required to hear and rate the audio for a given test sequence.

1.2.2. Transmission Impairment Test

The purpose of the transmission impairment tests is to ascertain expert observation and commentary regarding transmission impairment. In these tests the audio experts will listen to audio subjected to various levels of impairment and then provide a written comment on the effects of the impairment and on how the audio quality degrades with the level of impairment.

The impairments to be tested are random noise; impulse noise; and co-channel, NTSC-into-ATV, interference.

At least three audio experts are required to listen to and comment on the audio for a given test sequence. The method for reporting comments is the same as that used for "Expert Observation and Comment" tests, as described in the Video Subjective Test Procedures Manual.

1.3. Quality Rating Tests-Detailed Information

1.3.1. Presentation Order of Test Material

The actual test material shall consist of various types of audio program material in pseudo-random orders. The same two pseudo-random orders shall be used for all proponents. The pseudo-random sequence shall be such that the same audio material is never used in two consecutive trials.

1.3.2. Description of a Single Trial

A single trial consists of six presentations (two sets of three stimuli) of a given piece of test material. The following shows the whole sequence to be recorded on the tape:

A. Announcement: "Trial XX"
B. 2 seconds silence
C. Announcement: "First triple-stimulus presentation"
D. Program Material (known reference)
E. 2 seconds silence
F. Program Material (hidden reference or system under test)
G. 2 seconds silence
H. Program Material (hidden reference or system under test)
I. 2 seconds silence
J. Announcement: "Second triple-stimulus presentation"
K. Program Material (known reference)
L. 2 seconds silence
M. Program Material (hidden reference or system under test)
N. 2 seconds of silence
O. Program Material (hidden reference or system under test)
P. 10 seconds silence
Q. Announcement: "End of Trial XX"
R. 2 seconds silence

On some of the trials, the three stimuli will be presented in the following order: known reference - hidden reference - system under test. On some other trials, the presentation order will be: known reference - system under test - hidden reference.

During a session the order of presentation of the hidden reference and the system under test will change in a pseudo-random fashion. The same two pseudo-random orders will be used for all proponents and shall be specified to the testing laboratory by the FCC Advisory Committee.

1.3.3. Test Session Description

Prior to the beginning of a test session, formal instructions are given to the listeners. (These instructions are both written and oral.) At this point the trials begin.

For a given ATV system a test session shall consist of four demonstration trials followed by twenty actual trials, as each trial is repeated to check for reliability in results.

The duration of a typical test session will probably be about an hour. The instructional material and demonstration trials will probably use about ten to fifteen minutes of that time. There shall be a ten minute break after about forty minutes.

Each listener shall participate in only a single session.

A session shall be conducted with a maximum of five audio experts.

1.3.4. Minimum Number of Listeners

For any given rating test, at least twenty audio experts shall be used.

1.3.5. Rating Scale

The figure below shows the printed scale that the listeners will use to rate each trial:

5.0 - Imperceptible
4.0 - Perceptible, but not annoying
3.0 - Slightly annoying
2.0 - Annoying
1.0 - Very annoying

The expert listeners are told to grade the system under test and the hidden reference with respect to the known reference. Any difference should be considered an impairment and graded accordingly.

The expert listeners are also told that the scale is continuous and that they may indicate their opinion anywhere along the scale. (In reducing the data, accuracy shall be maintained to the tenth of a rating scale interval.)

1.3.6. Instructions to Audio Experts

The following instructions are both given in writing and announced via recording to each group of audio experts.

"This experiment is one of a series being carried out to evaluate new kinds of television for reception in the home. You are not asked to grade the audio quality of the test sequences, but the *impairments* on the system under test and the hidden reference compared to the known reference. All differences should be considered as an impairment."

"The experiment will consist of a series of evaluation trials. Each trial will involve..."

"We will now make four sample trials"

[PRESENT DEMONSTRATION TRIALS HERE]

"In the experiment, we will ask you to judge the overall quality of the sound you hear. To do this, you...(Describe rating scale and judgment task)"

"Have you any questions?"

[AFTER QUESTIONS, BEGIN ACTUAL TRIALS]

1.4. Transmission Impairment Tests-Detailed Information

1.4.1. Test Material

Three different audio selections shall be used.

1.4.2. Test Session Description

The sessions are informal. The tape may be played more than once. Discussion among the listeners is desirable. A consensus shall be used to write the comments and observations for each tape segment or selection. The audio experts should use the rating scale below to characterize each segment of the tape if a large enough range exists. The audio experts must also characterize the onset of unusability over the range of impairments on the tape.

The duration of a typical test session will probably be about an hour and twenty minutes. There shall be a ten minute break about forty minutes into the session.

1.4.3. Minimum Number of Listeners

For any given rating test, at least three audio experts shall be used.

1.4.4. Rating Scale

The figure below shows the printed scale the listeners should use to rate each tape segment or selection, if possible.

Circle One:

5 - Imperceptible
4 - Perceptible, but not Annoying
3 - Slightly Annoying
2 - Annoying
1 - Very Annoying

2 Definitions

2.1. Audio Experts

An expert listener is one who has recent and extensive experience assessing the types of impairment under test.

Prior to being used in testing, an audio expert must pass a hearing test that shows his/her hearing is within 25 dB of "audiometric normal" over the frequency range 250 Hertz to 8,000 Hertz.

2.2. Advanced Television System (ATV)

For the purpose of this document, advanced television systems (ATV) refers to any television system whose proponent represents it as having performance superior to that of NTSC.

3 Listening Conditions

3.1. General

All subjective tests shall be conducted in controlled listening environments. The sound reproducing equipment shall be calibrated prior to any testing, and the layout and room conditions shall be adhered to throughout the testing. These listening procedures have been adapted from IEC publication 268-13, Listening Tests on Loudspeakers, Sound System Equipment, Part 13.

3.2. Subjective Test Listening Conditions

3.2.1. Listening Room

A comfortable chair shall be provided for each listener.

The room shall be quiet and free from aural distractions.

The background noise level in the room shall be NC 20 or better.

The reverberation of the room shall comply to IEC specifications as outlined for a nominal listening room (22 x 13.5 x 9.2') with a maximum reverberation time of 0.8s from 20 Hz to 250 Hz and 0.42s from 250 Hz to 4 kHz and a minimum reverberation time of 0.25s from 250 Hz to 4 kHz.

The audio listening level shall be nominally 85 dB peak, C weighted on a sound level meter.

3.2.2. Use of Headphones

Headphones may be used for the Transmission Impairment tests only. Headphones may not be used for the quality tests. When headphones are used, the room acoustic requirements above may be relaxed.

3.2.3. Loudspeakers

The following describes the preferred arrangement and equipment complement.

The loudspeakers shall be angled with respect to the listening area as to give the most uniform coverage to the listeners possible. The reference axis of each loudspeaker shall be horizontal, 1.25 m above the floor, and pointed towards a point near the center of the listener seating area on the midline of the room. Loudspeakers shall be oriented so that the broadest dispersion of sound from the loudspeaker occurs in the horizontal plane passing through the reference axis.

The loudspeakers should be separated by at least 2 m. In smaller rooms it may be necessary to move the loudspeakers to within 0.5 m of the side walls to achieve the separation necessary for good stereophonic perspective. The nearest listener should be no less than 2 m, measured perpendicularly, from an imaginary line joining the loudspeakers. In general, the minimum listening distance should be 1.0 to 0.8 times the distance between the loudspeakers, i.e. the loudspeakers should subtend an angle of 550 to 650 at the nearest listener position. For good stereophonic

reproduction, the arrangement of loudspeakers and listeners should be symmetrical about the major axis of the room.

The two audio channels shall contain identical high quality loudspeakers, crossover networks and power amplifiers. Prior to testing, the gain of the audio channels shall be matched using pink noise to generate the identical sound pressure (using Slow C-weighting) at the center of the listening area. The same model loudspeakers, crossovers, and amplifiers must be used for all proponents.

3.2.4. Listener Positions

The listeners shall be arranged in a line on the axis of symmetry of the loudspeaker pair. If possible, listeners from front-to-rear of the line arrangement should be progressively elevated to give each head a clear acoustical "view" of all the loudspeakers under test.

Each listener should be placed at least 0.40 m from the side walls and at least 1 m from the back wall. The distance between listeners should be at least 0.60 m.

Chairs for listeners should have backs no higher than shoulder level to prevent acoustical interference with normal perception of the total room sound field. A maximum of five listeners may be used simultaneously.

4 Test Material

4.1. Quality Tapes

The test material shall be the following:

1	Susanne Vega	Track 1	00:22 to 00:42	A&M 395 136-2
2	Tracy Chapman	Track 6	00:36 to 00:57	Elektra 960 774-2
3	Glockenspiel	Track 35/1	00:00 to 00:16	EBU SQAM 422 204-2
4	Fireworks	Track 1	00:00 to 00:20	Pierre Verany 788031
5	Ornette Coleman	Track 7	All (:20)	Dreams 008
6	Bass Synthesizer	n/a	All (:25)	Special R-DAT*
7	Castanets	Track 27	00:00 to 00:20	EBU SQAM 422 204-2
8	Male Speech	Track 17/2	54:16 to 54:35	Japan Audio Soc. CD3
9	Bass guitar	n/a	All (:20)	Special R-DAT*
10	Haydn Trmpt Conc	Track 10	05:10 to 05:30	Philips 420 203-2

*Special R-DAT recording used in MPEG Tests

4.2. Transmission Impairment Tapes

The test material shall be the following:

1	Tracy Chapman	Track 6	00:36 to 00:57	Elektra 960 774-2
2	Glockenspiel	Track 35/1	00:00 to 00:16	EBU SQAM 422 204-2
3	Male Speech	Track 17/2	54:16 to 54:34	Japan Audio Soc. CD3

5 Preparation of Rating Audio Tapes

5.1. General Requirements

Each tape shall be recorded in the R-DAT format with time code reference. Each tape shall have at its beginning the following:

* 1 minute of 400 Hz 0 level tone

* Announcement containing the following information:

  > Copyright Notice
  > Serial Number of the Tape
  > Name of Proponent System Under Test
  > Type of Test: Quality or Transmission Impairment
  > If Transmission Impairment, then the impairment(s) being tested
  > Preparation Date of the Tape

* 10 seconds of silence

* Actual Test Material

5.2. Randomization of Quality Test Sequence

All test tapes for a given Quality test shall use the same test materials in the same two pseudo random orders.

5.3. Demonstration Sequence

The demonstration trials at the beginning of a quality tape session shall be material similar to that being used for the actual testing.

o Data Presentation

6.1. General

The exact methods to be used to reduce, analyze, and present the data are still under study. After the required number of audio experts have heard a particular quality test, the results shall be analyzed and the standard deviation calculated. If the standard deviation is large, the testing laboratory may recommend that additional testing be conducted with more audio experts to reduce the standard deviation.

6.2. Practice Trials

The first five trials of any Quality Test shall be deemed practice trials and shall not be used in the analysis of the test results.

7 List of Tapes Per Proponent

7.1. General

This section details the tapes to be prepared for each proponent system.

7.2. Quality Rating Tapes

Two Quality Rating Tapes shall be made for each proponent, one for each of two pseudo-random orders of test material.

7.3. Transmission Impairment Rating Tapes

Two Transmission Impairment Rating Tapes shall be made for each proponent.

The first shall be made to characterize the carrier-to-noise (C/N) performance of the proponent system. The six levels of impairment used shall be those found in the video C/N ranging tests.

The second shall be made to characterize the co-channel, NTSC-into-ATV, performance of the proponent system. The six levels of impairment shall be those found in the video co-channel ranging tests.